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STANDARD CANTILEVERED MASONRY RETAINING WALLS

This guide provides prescriptive reinforced masonry cantilevered retaining wall designs compliant with the Encinitas Municipal Code. This guide offers design alternatives for the construction of masonry retaining walls not exceeding 6 feet in height with level or sloping backfills. Sloping backfills shall have a maximum slope of 1.5 horizontal: 1 vertical. Note that retaining walls less than 3 feet in height do not require building permits.

I. LIMITATIONS

The retaining wall designs provided herein may not be used to retain expansive soils, surcharge loads, or to impound flammable liquids (for secondary containment). Furthermore, retaining walls provided in this guide may not be used in sites where the following geologic hazards exist:

- Fault zones/Ground Rupture
- Landslides/Potential Slope Stability
- Liquefaction/Potential Ground Failure
- Coastal Bluff Stability
- Variable Stability/Unfavorable Geologic Structure with Sloping Topography

Retaining walls not conforming to the design criteria in this guide shall be designed by a civil engineer, structural engineer, or architect licensed in the State of California and are subject to special inspection requirements specified in chapter 17 of the California Building Code. Retaining walls designed by licensed engineers or architects shall be submitted for plan review. Submittal package shall include plans and structural calculations. A geotechnical investigation may be required depending on project locations. All elements of retaining walls shall be maintained within the applicant's property; encroachments into neighboring properties shall not be allowed.

II. PLANNING REGULATIONS

For Planning purposes, the height of a retaining wall is measured from finished grade on the lower side of the retaining wall to the top of the retaining wall. Retaining walls that exceed six feet in height, and/or the grading required proposes earthwork cuts greater than eight feet in depth and fill greater than four feet in height, may require a design review permit. Please inquire with the Planning Division for additional information. The Encinitas Municipal Code regulates the location and height of retaining walls in the required lot setback and in visibility areas shall not exceed 3 feet in height.

Zoning overlay requirements (i.e., Coastal Bluff and Hillside/Inland Bluff Overlays) may result in additional requirements. Consultation with the Planning Division is highly recommended prior to submitting your retaining wall permit. You can contact Planning division staff at (760) 633-2710, via e-mail at planning@encinintasca.gov. You can also check specific zoning information and zoning overlays through the City's website.

Note: Retaining walls higher than 5 feet may require a grading permit.

III. SPECIFICATIONS

A. WALL HEIGHT

For structural design purposes, the wall height is measured from the top of the footing to the top of the wall (including wall caps). Wall configurations not covered in Tables 1, 2, or 3 of this document must be specifically designed for the actual proposed conditions by a registered design professional licensed in the State of California. Surcharge loads imposed by building foundations, driveways, parking areas, fences, etc. shall not be allowed on the wall's upper level within a distance equal to the overall difference in finished grade heights, see Figure 4.

B. CONCRETE

Footings shall be constructed with normal weight concrete; the concrete mix design used shall meet the following criteria:

- Minimum compressive strength of 3,000 psi at 28 days (CBC table 1808.8.1).
- Type II Portland cement conforming to ASTM C150.
- ¾" aggregate conforming to ASTM C33.
- Water conforming to ASTM C1602.
- Water-to-cement ration of 0.50.
- Slump between 2" and 5".

C. MASONRY BLOCKS

CMU (concrete masonry units) shall be medium weight units conforming to ASTM C90. SMU blocks shall have a minimum compressive strength of 2,000 psi and laid in running bond. CMU retaining wall assemblies shall be grouted solid.

All head and bed joints shall be ⅜" thick. Bed joints of the starting course over the concrete foundation may be between ¼" and ¾".

D. MORTAR

Type S or M mortar conforming to ASTM C270 shall be used in masonry construction.

E. GROUT

Grout shall have a minimum compressive strength of 2,000 psi and conform to ASTM C476.

F. REINFORCING STEEL

Reinforcing steel shall conform to ASTM A 615, Grade 60. ASMT A 615 Grade 40 may be used for #3 and #4 reinforcing bars only. Reinforcing shall be placed as specified in Figures 1a and 1b. Except for locations where control joints are installed per Figure 3, horizontal

reenforcing shown in Figures 1a and 1b shall be continuous; as an alternative, lap splices be spliced as specified in figures. All bars shall be clean of loose flaky rust, grease, or other materials likely to impair bond.

G. MORTAR KEY (Optional)

To improve bond between the footing and the first course of CMU blocks, a mortar key may be formed by embedding a flat 2x4 form flush with the top of the freshly placed footing. The flat 2x4 form shall be removed after the concrete has started to harden.

H. WALL DRAINAGE

Wall drainage shall be installed along the length of the wall, and it shall consist of a perforated drainpipe with a minimum diameter of 4 inches, protected with a filter fabric sock. Pipe shall discharge or connect to a storm water collection system. Wall draining discharging onto adjoining properties is prohibited.

I. BACKFILL

A 12” wide layer of gravel shall be placed directly behind the retaining wall. This gravel layer shall extend from the top of the footing to a height that is 12” below finished grade on the upper side of the wall. Balance of backfill shall be sandy or gravelly soil with Unified soil Classifications of GW, GP, SW, or SP per table 1610.1 of the California Building Code.

J. GUARDS

Guards shall be installed where the distance from finished grade on the low side of the retaining wall and a walking surface on the high side of the retaining wall is greater than 30 inches. Guards shall be 42 inches high and have openings meeting the requirements of section 1015.3 of the California Building Code. Only open railing guard configurations may be used in conjunction with the retaining wall designs specified in this document; guards with solid profiles are not acceptable. Retaining walls design accounts for guard load requirements specified in section 1607.8.1 of the California Building Code. The Planning Division will count the height of any guard rail toward the maximum allowable height of the wall, unless there is a minimum two-foot separation and landscape plantings between the retaining wall and the guard rail above. Any combination retaining wall/fence/guard rail that exceeds six feet in height may require a design review permit.

K. FENCES

Fences shall not be installed on top of the retaining wall designs specified in this document.

IV. CITY INSPECTIONS

City inspections must be performed during several phrases of construction; see the City’s website for information on how to prepare for and schedule inspections. Inspections shall be performed at the following times:

- A footing inspection shall be performed once footing excavation procedures are complete and the reinforcing steel is securely tied in its final position, but before concrete is poured.
- A pre-grout inspection shall be performed once the CMU blocks have been laid and the reinforcing steel is securely tied in its final position, but before the wall is grouted solid.
  - If cleanout holes are used, CMU blocks may be laid to the full wall height before calling for the pre-grout inspection. Grout shall then be placed in a continuous poor.
  - If cleanout holes are not used, a masonry pre-grout inspection is required prior to each grout pour. CMU blocks shall not be laid higher than the grout pour. Note that cleanouts are required for all grout pours over 5 feet in height.
- A backfill/drainage inspection shall be performed after grouting is completed and wall drains are in place, but before earth backfill is placed.
- A final inspection shall be performed once all work has been completed.

Figure 1a / Typical Retaining Wall with Level Backfill

Note: See Table 1 for dimensions and reinforcing size and spacing.

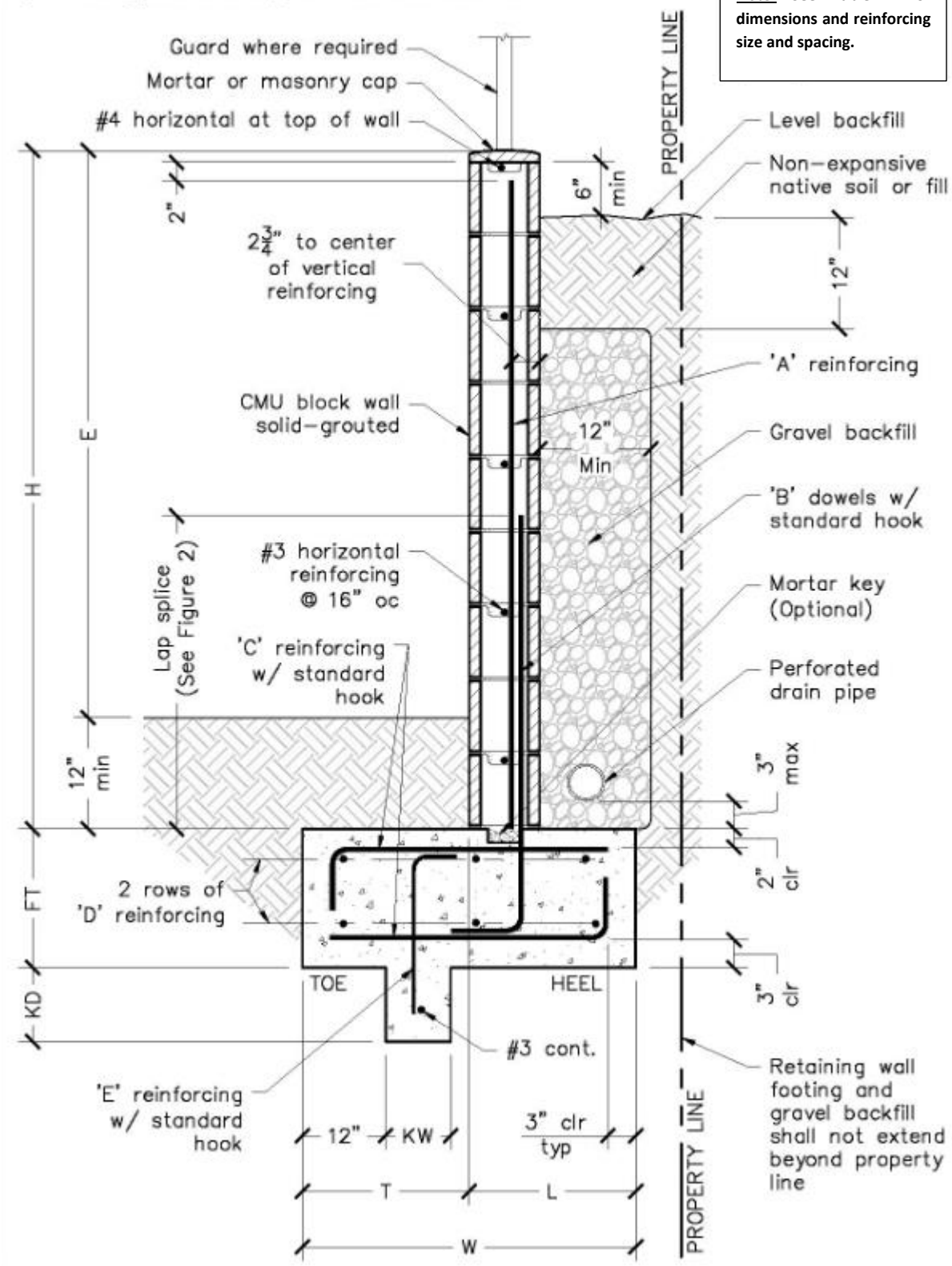
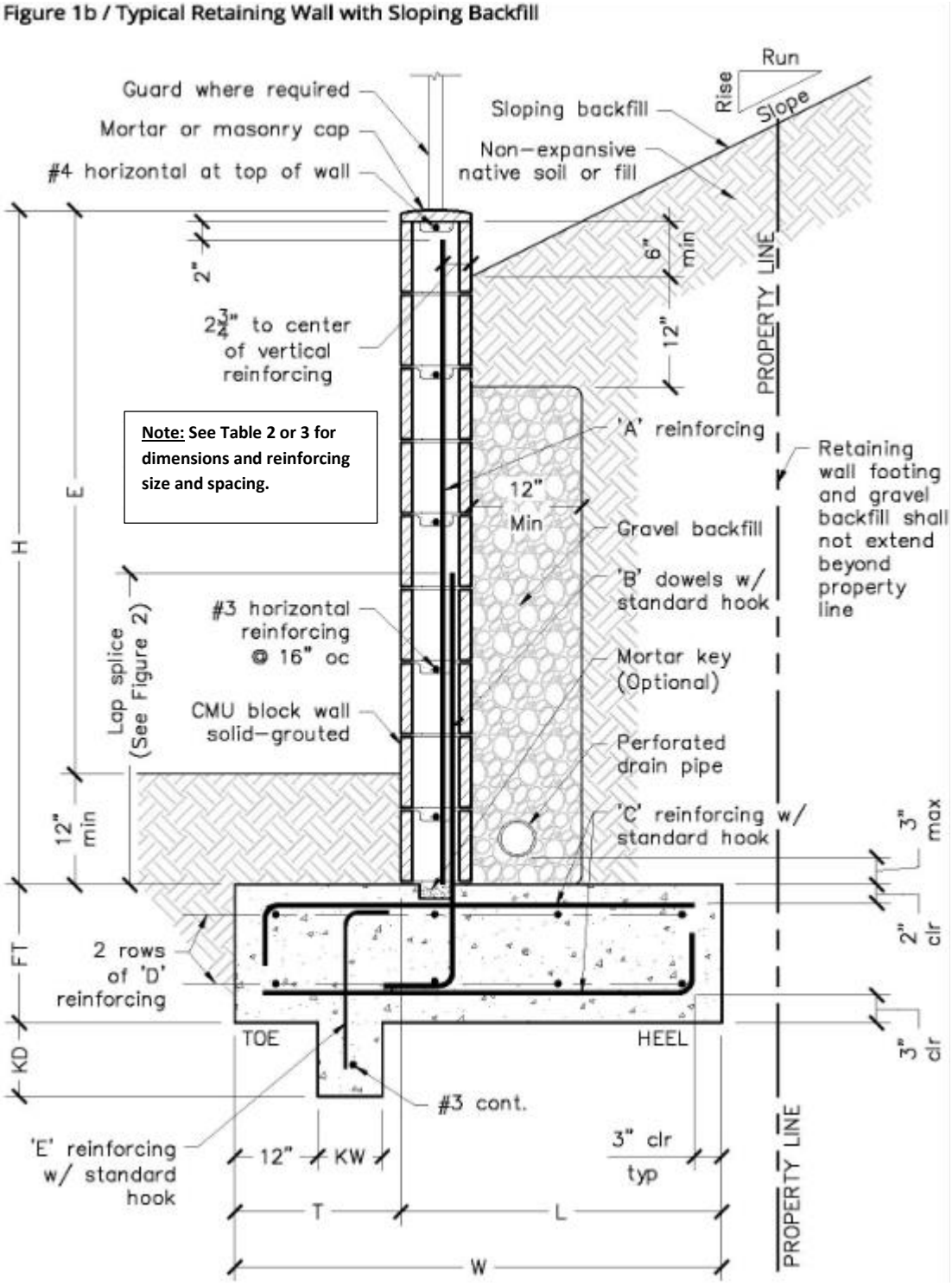


Table 1 / Requirements for Various Heights of Retaining Walls with Level Backfill

Wall Height (H)	3'-4"	4'-0"	4'-8"	5'-4"	6'-0"
Exposed Wall Height (E)	2'-4"	3'-0"	3'-8"	4'-4"	5'-0"
CMU Block Size	6"	8"	8"	8"	8"
Footing Width (W)	1'-9"	2'-0"	2'-3"	3'-0"	3'-0"
Heel Dimension (L)	1'-3"	1'-6"	1'-6"	2'-0"	2'-0"
Toe Dimension (T)	6"	6"	9"	1'-0"	1'-0"
Footing Thickness (FT)	10"	10"	10"	10"	10"
A Reinforcing	#3 @ 32"	#3 @ 32"	#3 @ 16"	#3 @ 24"	#3 @ 16"
B Reinforcing	#3 @ 32"	#3 @ 32"	#3 @ 16"	#4 @ 24"	#4 @ 16"
C Reinforcing	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"
D Reinforcing (Top & Bottom Total)	2-#3 (4 total)	3-#3 (6 total)	3-#3 (6 total)	4-#3 (8 total)	4-#3 (8 total)
E Reinforcing	-	-	-	-	#4 @ 16"
Key Width (KW)	-	-	-	-	6"
Key Depth (KD)	-	-	-	-	6"

*See Figure 1a for retaining wall configuration.

Figure 1b / Typical Retaining Wall with Sloping Backfill



Note: See Table 2 or 3 for dimensions and reinforcing size and spacing.

Table 2 / Requirements for Various Heights of Retaining Walls with Sloping Backfill Slope = 2 Horizontal : 1 Vertical

Wall Height (H)	3'-4"	4'-0"	4'-8"	5'-4"	6'-0"
Exposed Wall Height (E)	2'-4"	3'-0"	3'-8"	4'-4"	5'-0"
CMU Block Size	6"	8"	8"	8"	8"
Footing Width (W)	1'-9"	2'-3"	3'-3"	3'-6"	3'-6"
Heel Dimension (L)	1'-3"	1'-6"	2'-6"	2'-6"	2'-6"
Toe Dimension (T)	6"	9"	9"	1'-0"	1'-0"
Footing Thickness (FT)	10"	10"	10"	10"	10"
A Reinforcing	#3 @ 24"	#3 @ 24"	#4 @ 24"	#4 @ 16"	#4 @ 16"
B Reinforcing	#3 @ 24"	#3 @ 24"	#4 @ 24"	#4 @ 16"	#5 @ 16"
C Reinforcing	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"
D Reinforcing (Top & Bottom Total)	2-#3 (4 total)	3-#3 (6 total)	4-#3 (8 total)	4-#3 (8 total)	4-#3 (8 total)
E Reinforcing	-	-	-	#5 @ 16"	#5 @ 16"
Key Width (KW)	-	-	-	6"	6"
Key Depth (KD)	-	-	-	8"	1-'0"

*See Figure 1b for retaining wall configuration.

Table 3 / Requirements for Various Heights of Retaining Walls with Sloping Backfill Slope = 1.5 Horizontal : 1 Vertical

Wall Height (H)	3'-4"	4'-0"	4'-8"	5'-4"	6'-0"
Exposed Wall Height (E)	2'-4"	3'-0"	3'-8"	4'-4"	5'-0"
CMU Block Size	8"	8"	8"	8"	8"
Footing Width (W)	2'-3"	3'-0"	3'-6"	4'-3"	4'-6"
Heel Dimension (L)	1'-9"	2'-3"	2'-6"	3'-3"	3'-6"
Toe Dimension (T)	6"	9"	1'-0"	1'-0"	1'-0"
Footing Thickness (FT)	10"	10"	10"	10"	10"
A Reinforcing	#3 @ 24"	#3 @ 24"	#3 @ 16"	#4 @ 16"	#4 @ 16"
B Reinforcing	#3 @ 24"	#4 @ 24"	#4 @ 16"	#5 @ 16"	#5 @ 16"
C Reinforcing	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"
D Reinforcing (Top & Bottom Total)	3-#3 (6 total)	4-#3 (8 total)	4-#3 (8 total)	5-#3 (10 total)	5-#3 (10 total)
E Reinforcing	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"	#5 @ 16"
Key Width (KW)	6"	6"	8"	8"	10"
Key Depth (KD)	6"	6"	1-'0"	1'-3"	1'-8"

*See Figure 1b for retaining wall configuration.

Figure 2 / Typical Reinforcing Hooks, Bends, and Splices

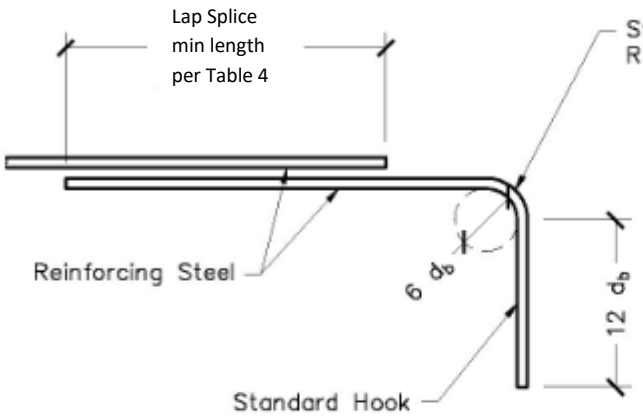
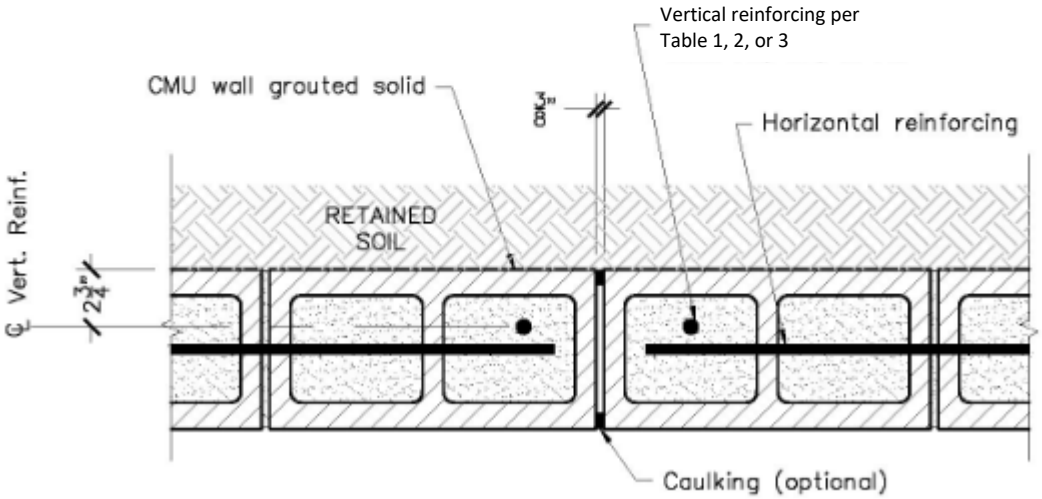


Table 4
Lap Splice Length

Size	Bar diameter d_b	Lap CMU	Lap Conc.
#3	3/8"	12"	21"
#4	1/2"	20"	28"
#5	5/8"	30"	36"

Figure 3 / Typical Control Joints



Note: Control joint spacing shall not exceed 25' on center

Figure 4 / Surcharge and Slope Setbacks